Uncertainties

DOE does not have a quantitative estimate of uncertainty associated with the ground water modeling predictions estimating the time for ground water concentrations to reach levels protective of aquatic species. Sections 7.3.5.5, 7.6, and 7.8.3 of the SOWP (DOE 2003a) discuss the sensitivity of the ground water flow and transport model to specific modeling input parameters as well as modeling uncertainty. Specifically, transport parameters (e.g., tailings seepage concentration and the natural degradation of ammonia in the subsurface) were found to have a much greater impact on predicted concentrations than did flow parameters (e.g., hydraulic conductivity and effective porosity). The sensitivity analysis performed indicates that perturbing the key transport parameters from the calibrated values could result in either significantly higher or significantly lower contaminant concentrations in the ground water adjacent to the river: it did not indicate the probability or likelihood of any one outcome.

Many variables affect prediction accuracy, and the system of contaminant transport and the interaction between ground water and surface are complex, largely due to the dynamic nature of river stage and backwater area morphology. To compensate for the inherent uncertainties, DOE has assumed a conservative protective water quality goal of meeting the lowest possible acute aquatic standard (based on the range of observed pH and temperature conditions in the river) in the ground water with no consideration of dilution. Model predictions, supported by site-specific data, also indicate that long-term ground water concentrations adjacent to the river (background for the off-site disposal alternative and 0.7 mg/L ammonia for the on-site disposal alternative) would be protective for chronic exposure scenarios for all but the worst-case pH and temperature conditions without any consideration of dilution from the surface water.

On the basis of site-specific data and a study of site conditions, DOE has a reasonable degree of confidence that protective conditions would be met and maintained during both the operation of the corrective action and following achievement of water quality goals. To ensure that protective conditions were met, DOE would monitor the ground water and surface water systems and would hold regular consultations with USF&WS. In addition, the active remediation system would continue throughout the 75- to 80-year remedial action period and into the post-remedial action confirmation monitoring period.

A1−5.0 Description of Project Areas

Preliminary consultations and investigations indicate that listed threatened or endangered terrestrial wildlife species are not known to occur, nor are they strongly expected to occur, at the Moab, Klondike Flats, Crescent Junction, or White Mesa Mill sites. The proposed pipeline corridor to the White Mesa Mill site provides the greatest potential for terrestrial threatened or endangered species to be present. However, before developing any disposal site, DOE, in consultation with USF&WS, would determine the need for additional habitat evaluations and surveys for species that could be affected. If threatened or endangered species or critical habitats were identified at a selected site, a mitigation plan would be developed to minimize potential adverse impacts. If impacts could not be avoided, additional Section 7 consultation would be required.

A1−5.1 Moab Site

A1−5.1.1 Terrestrial Setting

Historically, the entire Moab site has been created and altered by natural events such as floods and, more recently, by the activities related to milling operations. At present, significant vegetation does not occur on approximately 380 acres of the site; this severely limits use of this area by terrestrial wildlife. Mature tamarisk, with minimal understory, covers approximately 50 acres of the site east of the tailings pile on the Colorado River floodplain. This area provides some habitat for birds and small mammals. Steep rock mesas dominate the area just west of the site. Low-growing desert shrub communities and low-density piñon-juniper forest are the predominant vegetation types to the west and north of the site along the transportation routes.

The upland soils at the site are Nakai sandy loam. The potential indigenous vegetation that might occur if the site were not disturbed from past mill operations includes grasses such as Indian ricegrass (*Achnatherum hymenoides*) and galleta (*Pleuraphis jamesii*) and the desert shrubs fourwing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), and winterfat (*Krascheninnikovia lanata*). This potential vegetation could provide habitat for small mammals, including white-tailed prairie dog (*Cynomys leucurus*), desert cottontail (*Sylvilagus audubonii*), and black-tailed jackrabbit (*Lepus californicus*). Fourwing saltbush, shadscale, and galleta may be used to some extent by mule deer (*Odocoileus hemionus*) as forage.

The existing vegetation reflects a history of disturbance. Plants observed during April 2003 include spike dropseed (*Sporobolus contractus*), sand dropseed (*Sporobolus cryptandrus*), tamarisk (*Tamarix parviflora*), black greasewood (*Sarcobatus vermiculatus*), gray rabbitbrush (*Ericameria nauseosa*), Douglas rabbitbrush (*Chrysothamnus viscidiflorus*), big sagebrush (*Artemisia tridentata*), and galleta. The presence of tamarisk and low-density black greasewood indicates that ground water occurs within 20 to 50 ft of the surface.

A narrow strip of riparian habitat along the eastern site boundary between the upper floodplain terrace and the Colorado River also contains wetland plants and soils. This area includes the sandbar areas downstream of Moab Wash. The area was assessed but not formally delineated in February 2002. The presence of wetland vegetation and soils and predominance of water would likely qualify at least a portion (estimated at approximately 1 acre) of this area as U.S. Army Corps of Engineers jurisdictional wetlands. Seedling tamarisk is the predominant plant in these wetland areas; other wetland plants include saltgrass *(Distichlis spicata)*, cattail *(Typha sp.*), rush (*Juncus sp.*), bulrush *(Scirpus sp.)*, spikerush (*Eleocharis sp.*), redroot flat sedge (*Cyperus erythrorhizos*), and sandbar willow (*Salix exigua*).

Other riparian areas at the Moab site do not meet the criteria for classification as jurisdictional wetlands. These include the wooded areas of tamarisk and other species on the floodplain and an area of woody and emergent vegetation surrounding a holding pond for water pumped from the river.

Vegetation across the Colorado River, including the Scott M. Matheson Wetlands Preserve (Matheson Wetlands Preserve) on the river's east bank, includes habitat that consists of riparian woodland, grassland, and shadscale (saltbush) communities. Woodland, dominated by tree species such as black willow (*Salix nigra*) and Fremont cottonwood (*Populus fremontii*), is present in the preserve. Other plants include tamarisk, sedges (*Carex* spp.), bulrush, and cattail (NRC 1999). More than 175 species of birds have been observed at the Matheson Wetlands Preserve, and a great blue heron (*Ardeaherodias*) rookery is present in its lower end (NRC 1999). The Matheson Wetlands Preserve has a variety of wetland types that include emergent wetlands, shrub wetlands, cottonwood stands, and ponds. It is the only sizable wetland remaining on the Colorado River in Utah and serves multiple environmental functions, including water quality preservation, flood protection, erosion control, and biological productivity and diversity.

A1−5.1.2 Aquatic Setting

The Moab site lies immediately adjacent to the Colorado River, the principal surface water resource for the area. The tailings pile is approximately 700 ft west of the river. The site is located on an alluvial terrace, which historically floods through the area, along the Moab Wash and into the Colorado River. The tailings pile is located within the 100-year recurrence interval storm floodplain of the Colorado River and within the floodplain of the probable maximum flood (PMF) of both the Colorado River and Moab Wash. Mussetter and Harvey (1994) identified two Colorado River flows that are significant for the Moab site. At a flow of approximately 40,000 cfs, the river elevation exceeds its banks and floods the Matheson Wetlands Preserve. There were a total of seven years from 1959 to 2002 when flows were greater than 40,000 cfs. The other critical flow occurs at about 70,000 cfs, which, according to Mussetter and Harvey (1994), produces a river elevation such that river water comes in contact with the toe of the tailings pile. Based on an analysis of the flow data from the gaging station upstream at Cisco, there has only been one day (in 1984) since 1959 in which the flow has exceeded 70,000 cfs. Section 3.1.8 of the EIS and Section 5.2 of the SOWP (DOE 2003a) provide further discussion of the floodplains and hydrology. The major tributaries of the Colorado River near the site include the Dolores River (located upstream) and the Green River (located downstream). The Matheson Wetlands Preserve is on the east bank of the Colorado River, across from the Moab site. Sections 3.1.1 and 3.1.7 of the EIS describe the geology and surface water further.

The aquatic species within the vicinity of the Moab site are associated with the Colorado River. The Colorado River has seasonal variations in flow and temperature following a snowpack-driven hydrograph (DOE 2003b). Aquatic species in the river have adapted to physical and chemical conditions that fluctuate naturally, both seasonally and daily. These conditions include river flow and flooding of intermittent backwaters and elevated floodplains, bottom scouring by sand and silt, temperature, sediment loading, chemical composition, and salinity (NRC 1999).

The Moab site is located at approximately river mile 64 on the Colorado River (NRC 1999) in a transition zone between two geomorphically distinct reaches. River miles on the Colorado River have been designated for the purposes of research programs; the beginning of the designation is at the confluence of the Green River into the Colorado River (Belknap and Belknap 1991; Osmundson et al. 1997). The immediate reach of the Colorado River upstream of the site is predominantly sand-bedded with a few cobble bars. Directly downstream of the site, the river is sand-bedded with sandbars and stabilized islands. A portion of the shoreline near the site has been stabilized by tamarisk, an invasive species, or stabilized with riprap. The tamarisk can form

cut banks that erode to some degree with each large flood. The shoreline at the Matheson Wetlands Preserve opposite the site has been diked and is heavily colonized by tamarisk (NPS 2003).

The State of Utah has classified the river segment adjacent to the Moab site as protected for warm-water species of game fish and other warm-water aquatic life, including necessary aquatic organisms in their food chain. Macroinvertebrate samples were collected at six locations in the vicinity of the site in 1999 (USGS 2002). At each location, a sample was collected 3 ft, 15 ft, and 30 ft from the shoreline. Over 40 macroinvertebrate taxa, including chironomids and oligochaetes, were found during this sampling effort. Rooted macrophytes (i.e., plants), along with algae and zooplankton, have been found in the intermittent backwater areas but are almost nonexistent in the main channel (NRC 1999). The backwaters and inundated floodplains often serve as important nurseries and forage suppliers for fish, including the endangered Colorado pikeminnow (Valdez and Wick 1983). Both native and non-native species are present in this reach of the Colorado River, including four federal endangered species (NRC 1999). Trammell and Chart found twelve non-native species and only five native species in surveys conducted from 1992 through 1996 (Trammell and Chart 1998).

Many components of the upper Colorado River ecosystem have changed over the last several decades. One change that affects the aquatic life of the river near Moab is the establishment of introduced, or non-native, fish species. The upper basin contains about 20 species of warm-water, non-native fish (USF&WS 2002a). The red shiner (*Cyprinella lutrensis*), common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), channel catfish (*Ictalurus punctatus*), northern pike (*Esox lucius*), and green sunfish (*Lepomis cyanellus*) are the non-natives considered by Colorado River Basin researchers to be of greatest concern because of their suspected or documented negative interactions with native fishes (USF&WS 2002a). These introductions, in concert with the physical and chemical alterations of the river, may have contributed to the decline of the native fish populations (Trammell and Chart 1999, NRC 1999, Muth et al. 2000; USF&WS 2002a). Chapter 3.0 of the EIS describes the aquatic setting further.

A1−5.2 Klondike Flats

The proposed Klondike Flats disposal site is located on land administered by BLM about 18 miles north of the Moab site and just west of US-191 (Figure A1−6). The Klondike Flats site is remote and is located behind a low bluff such that the site is not visible from the highway. There are no perennial streams or other surface water features in or near this area; therefore, there are no significant aquatic ecological resources or wetlands that would be affected at the site. A portion of the site under consideration is designated for disposal in BLM's resource management plan (BLM 1983). The Grand County landfill is located within the area identified for disposal. The Canyonlands Field Airport is located immediately southeast of the Klondike Flats site. Access to the Grand County landfill is approximately 1 mile north of the Klondike Flats site and 1 mile west of US-191 on CR-236. Crescent Junction and the I-70 interchange are approximately 10 miles north of the site along US-191.

Plant abundance and diversity are generally very low, even for arid rangeland, because the low-permeability soils promote rapid runoff, have low water-holding capacity, and are often highly saline. Rooting depths vary from 5 to 20 inches. Extant vegetation on Chipeta soil within the Klondike Flats site is similar to the potential natural vegetation described in the Grand County Soil Survey (USDA 1989), which has limited value for grazing because of low productivity and poor palatability of dominant species. In upland areas, vegetation is dominated by low saltbushes (mat and Gardner saltbush [*Atriplex corrugata* and *Atriplex gardneri*]) with scattered shadscale, bud sagebrush (*Picrothamnus desertorum*), galleta, Indian ricegrass, and desert trumpet (*Eriogonum inflatum*). Maximum vegetative cover is about 50 percent. Prickly pear cactus, a grazing increaser that occurs in upland areas, is evidence of past overgrazing. A few hedgehog cacti (*Echinocereus* spp.) were also observed in upland areas. At the confluence of drainages where greater amounts of moisture occur seasonally, vegetation consists of abundant rubber rabbitbrush with a relatively dense understory of galleta, indicating that a slight increase in moisture can significantly increase plant abundance.

Water bodies in the vicinity of the Klondike Flats site consist primarily of ephemeral washes that are dry most of the year. The water from these washes eventually flows into either the Green River or the Colorado River. There are no wetlands in the area; however, there are several springs and wells nearby. These water sources are small, and nearby vegetation is primarily tamarisk.

The area surrounding and including the Klondike Flats site is available for recreation and other uses; however, existing access is limited to several dirt roads that are used for recreational access. Favorable weather allows off-road access for hikers, campers, mountain bikers, and off-highway vehicles during most of the year. Most recreational activities occur south of the Klondike Flats site along CR-138, also known as the Blue Hills Road. This road provides access to desirable areas to the west that are used mainly for mountain biking and off-highway vehicles. Although the amount of recreational use west of the site is unknown, it is possible that as many as 53,000 recreational use visits occurred during 2002. In addition to recreation, BLM allows grazing, oil and gas leasing, and mining claims. The Klondike Flats site area is part of the Big Flat grazing allotment, which is currently under a grazing permit until 2013.

Transportation of materials between the Moab site and the Klondike Flats site would occur along the US-191/Union Pacific Railroad corridor. An existing natural gas pipeline right-of-way would be followed if a slurry pipeline were selected to transport materials. From the Moab site to the north for approximately 7 miles, this transportation route climbs through a relatively broad but steep-walled canyon with many side canyons.

A1−5.3 Crescent Junction

The proposed Crescent Junction disposal site is located on BLM-administered lands about 2 miles north of the town of Crescent Junction, which is an interchange on I-70 and US-191 (Figure A1−7). The site is about 30 miles north of the Moab site and covers several square miles of largely desert terrain that is bordered on the north by the prominent Book Cliffs. No perennial streams are present, but ephemeral streams may carry high flows during heavy rains. Because no perennial streams or other surface water bodies are present on the Crescent Junction site, aquatic ecological resources and wetlands would not be adversely affected by activities at this site.

In most areas of the site, vegetation is indicative of disturbance and varies from the potential native vegetation. About 50 percent of the Crescent Junction site is covered by very sparse low-growing vegetation. The northern part of the site is covered with a gray veneer of debris from a recent outwash originating in the nearby Mancos Shale hills. The outwash area is mostly bare with some prickly pear cactus, cheatgrass (*Bromus tectorum*), and Russian thistle (*Salsola kali*). Vegetation in the south-central and southeast portions of the site also consists primarily of these three species with a few native shrubs and perennial grasses, including gardner saltbush, galleta, and Indian ricegrass. Range condition in this area would probably rate as poor to fair.

Vegetation in the southwest portion of the site is probably influenced by a shallow aquifer and consists of sparse shrubs, including black greasewood, shadscale, and gardner saltbush. Understory vegetation consists primarily of annual weeds, such as cheatgrass and Russian thistle, with a few perennial grasses (galleta, Indian ricegrass). Tamarisk occurs occasionally in the drainages.

Water bodies in the vicinity of the Crescent Junction site consist of ephemeral washes that are dry most of the year. The water from these washes eventually flows into the Green River. There are no known wetlands in the area.

Although not designated by BLM as a recreational area, the site has no access controls and the area is used for hiking, biking, and camping. While the Crescent Junction area is designated as access-limited, it can be accessed by secondary dirt roads and may thus incur off-road vehicle use. The site is part of the Crescent Canyon grazing allotment, which is currently under a grazing permit until 2010. Currently, all sections of interest for the potential Crescent Junction site are held by oil and gas leases, although none are in production.

Transportation to the Crescent Junction site would be along US-191 or the Union Pacific Railroad. A slurry pipeline would follow existing natural gas pipeline rights-of-way. Transportation to the Crescent Junction site would also pass through the canyon area north of Moab.

A1−5.4 White Mesa Mill

The proposed White Mesa Mill disposal site is located in San Juan County, Utah, approximately 5 miles south of Blanding, Utah. The proposed disposal cell site (Figure A1−8) is situated within 5,415 acres of property owned primarily by International Uranium (USA) Corporation (IUC). Existing facilities at the site consist of a mill, ore storage pad, and four lined tailings cells with leak detection systems and ground water monitor wells. The mill itself occupies approximately 50 acres, and the tailings disposal ponds occupy approximately 450 acres. The site is accessible from a half-mile-long private road connected to US-191. Other than the tailings disposal ponds, no perennial surface water is present at the White Mesa Mill site. Wetlands at the site are restricted to very small areas where perched ground water discharges to springs and seeps along Westwater Creek Canyon and Cottonwood Creek Canyon to the west-southwest of the site and along Corral Canyon to the east of the site near the Burro Canyon Formation. Ruin Spring, about 2 miles southwest of the millsite, is the only spring that is known to flow on a consistent basis. The other springs and seeps have not been known to flow year-round, although plants such as cattails have been observed around the seep in Cottonwood Canyon.

At the White Mesa Mill site, several areas were chained (to remove unwanted vegetation) to support an active cattle ranch prior to mill operations. These areas were reseeded but are now mostly void of vegetation due to overgrazing. Current vegetation consists primarily of crested wheatgrass and invasive weeds. Annual weeds, rabbitbrush, snakeweed, sagebrush, and cheatgrass dominate vegetation in the surrounding areas, which include some abandoned dry farms. Areas that were neither cultivated nor chained support sagebrush communities with a sparse understory of grasses, including galleta and crested wheatgrass. Forbs are rarely found. Potential vegetation consists of more than 50 percent palatable grasses such as western wheatgrass, Indian ricegrass, needle-and-thread grass, and squirreltail; 15 to 20 percent increaser grasses, including galleta and blue grama; 25 percent decreaser browse plants, including winterfat; and 5 to 10 percent big sagebrush, ephedra, and other shrubs.

Truck transportation between Moab and the White Mesa Mill site would be along US-191. There is no existing rail route south of Moab; therefore, rail transport to White Mesa Mill is not considered an option. A slurry pipeline would follow mostly existing rights-of-way through federally administered lands. However, approximately 29 miles of new rights-of way would be required, which would occur in an area that likely supports a greater diversity and abundance of vegetation and wildlife than the other pipeline routes. For example, the region near Monticello, Utah, north of the White Mesa Mill site where the new right-of-way would pass, supports piñon-juniper forests, and scattered ponderosa pine stands dominate this zone at higher elevations.

Recent NRC environmental assessments for the White Mesa Mill site concluded that no threatened or endangered species were being adversely affected by current mill operations (IUC 2003).

A1−6.0 Borrow Areas

Preliminary consultations and investigations do not indicate the presence of threatened or endangered species at borrow sites. However, the proposed borrow areas may need further evaluation to determine habitat, species presence, and other ecological characteristics. Preliminary evaluations of these areas indicate that no aquatic resources are present. Before developing any borrow area, DOE, in consultation with USF&WS and BLM, would determine the need for habitat evaluations and surveys for species that may be affected. If threatened or endangered species or critical habitats were identified on a selected area, a mitigation plan would be developed or a different borrow area would be selected, in order to minimize or eliminate impacts. If impacts could not be avoided, additional Section 7 consultation would be required. Figure A1−3 shows the borrow area locations.

A1−6.1 Crescent Junction Borrow Area

The Crescent Wash borrow area is located within the Crescent Junction disposal site and shares the same environmental features.